LCBA MONTHLY MEETING NOTES: OCT 8TH

Speaker: Dr. Tim Lawrence: Tim has been keeping bees for decades: his undergraduate degree was in entomology, but then he "drifted" into sociology for his master's and doctorate: his special focus is the human dimension of environmental issues, and at this meeting, he focused on the human elements in honey bee decline. Tim is the Extension Director of Island County and worked with Dr. Steve Sheppard at WSU to sample bee bread from 148 apiaries all over the state, including several in Lewis County, looking for traces of neonicotinoids. What they found may be surprising to some, and contains a welcome ray of hope in the bee decline story.

The Human/Honey Bee Relationship: Tim emphasized that we humans are part of the environment we share with our bees, though human beings often tend to see ourselves as separate. The human/bee relationship is ancient: up until about 1500 C.E., though, that relationship consisted mainly of people robbing honey from bees, and not just honey: brood was eaten as a protein source (and still is in other countries). Starting around1500, though, people began to practice rudimentary bee management, attempting to learn more about bee biology and ways of keeping bees alive. As many beekeepers know, the major leap forward came in 1851, when Rev. Lorenzo Langstroth discovered "bee space," the 3/8" gap between frames that allows bees to move on two frames simultaneously, leading to his creation of the movable frame hive. This revolutionary move enabled us to remove frames from the colony to examine our bees and extract honey without destroying the hive. We take "bee space" for granted now, not necessarily appreciating how much it aids our understanding of what goes on in our bee colonies. Next, Moses Quinby (1810 – 1875), became the first commercial beekeeper in the U.S., maintaining 1200 colonies in New York, both for honey production and pollination, opening the door to our present situation.

How Do We Assign "Value" to Honey Bees? Now, however, pollination is the focus of the huge modern beekeeping industry, with 2.3 million hives in the U.S. today. Tim himself was a commercial beekeeper for many years, and suggested that the USDA's slide on the value of honey bees may understate matters when they note that bees yield $16.5 billion dollars/year in pollination value. Tim doesn't like the "1 in every 3 bites of food you take, you owe to a honey bee" truism: it is more vivid and accurate to note that honey bees and related pollinators are responsible for a large number of food groups. Many crops are wind pollinated (though bees can and do pollinate crops like tomatoes, improving yield): this means that humans would not starve without bees, but our diet would be awfully bland.

Almonds Drive the Commercial Bee Industry: In the U.S. 50% of all bee colonies in America are moved to California at the start of each year to pollinate over 800,000 acres of almond trees – 85% of the world's almond crop. Mexican beekeepers would love to come in, but the border is closed to them. Some stats: 680,000 bearing acres; 115,000 non-bearing acres; 26,724 new acres are planted each year. All these acres require 1.6 to 2 million bee colonies to get their trees pollinated. The average price for pollination in 2014 was $180 to 200 per colony, up from $135 in 2010. Once the almonds are "done,"

their owners want the beekeepers out, so the bees go back on the trucks, fanning out around the nation: some go to Texas, Louisiana, Florida to pollinate assorted fruits, then on to New England to pollinate cranberries. Others come up to the Pacific Northwest, especially Washington, for berry and apple pollination, then on to Montana and the Dakotas for honey production. How significant a problem is stress on bees from all this transport? A study by Jeff Pettis recently showed that data doesn't support the idea that all this movement is bad: the 5 to 10 percent loss reported is within the range considered acceptable by commercial beekeepers. [One problem related to transport, though, is that bees get exposed to parasites and diseases by other bees.]

The Commercial Queen Rearing Industry: Another aspect of the beekeeping industry is worth scrutiny when we think about bee decline: the commercial queen rearing and package bee industry. G.M. Doolittle developed the first queen rearing system and is attributed with starting the package bee business. Today about a million queens a year are replaced: not quite 40% of beekeepers re-queen yearly. The quality of queens – their longevity – has been reduced (more on that below). Queens sell now at an average price about $20; package bees sell for about $22/pound (there are usually 3 pounds in a package of bees). Back when Tim was in the industry, lots of bees were exported to Canada: a cozy relationship until 1987, when tracheal mites came in, followed by the inroads made on bee populations by Varroa mites. Tim was the president of the California Beekeepers' Association, and he can attest that this was a rough period, featuring quarantine areas . . . literally, fist-fights broke out at California beekeepers' meetings, mainly over the question of how to manage the industry with imports and exports of bees banned. Today, Tim says that tracheal mites are no longer a significant issue because we were able to select against them [more on that below].

The Genetic Bottleneck: In 1922, U.S. borders were closed to importation of bees; in 1956, even bee semen was banned. This created a genetic bottleneck, which has created much of our trouble keeping bees alive – when a population lacks genetic diversity, it is easier for disease to take hold. No imports were permitted until the early 1990s. In modern queen production, fewer than 500 breeder queens produce all the one million queens produced annually: some say as few as 350 actual queens being grafted from, a really small genetic pool. Many beekeepers have met Tim's wife, Sue Cobey, who goes to Europe with Steve Sheppard's WSU team each year: they deal with a quarantine station even bringing semen back into the U.S., with samples and progeny sent to the USDA lab in Beltsville for analysis for viruses: the semen can't be released until the lab clears the samples. However, gradually they are bringing in more genetic lines, focusing mainly on the New World Carniolans, Italians, and Caucasian bees. A new focus is Apis mellifera pomelii, from Kirkistan, where apples evolved: the apple industry is contributing funding to see if we can bring this bee, adapted to pollinate apples, into the U.S..

What Traits Do Commercial Queen Rearers Select For? Tim showed a list of favorable characteristics in bee breeding: pollen and honey productivity; temperament; hygienic behavior; brood viability; spring buildup; swarming tendency; color; Nosema resistance; reduced susceptibility to Varroa and tracheal mites. Note: other than color, each trait is a behavioral trait. How do breeders graft and select? This takes a lot of work, though it is do-able. Now pressure on breeders to breed selectively is low "because anything with six legs sells."

Is Colony Collapse Disorder Really a Thing? Tim really doesn't like the term "CCD." In the 1970s, the same phenomenon was called "disappearing disease," and we still don't know its definitive cause: there are many factors. WSBA reported a 39% loss of bees in our state in 2009-10. Yet these losses are fluid: beekeepers will always manipulate colonies and still have some not make it. In Tim's opinion, the stress Varroa mites put on a colony – and what we are doing to control these mites – are causing the worst of our losses. The problem is not only the mite, but our response to it. How many chemicals are mites no longer susceptible to? Fluvalinate, Amitraz, and others have been used for over 25 years. Once, beekeepers could treat twice a year and have good control; however, Dennis van Engelsdorp just did a study that showed four treatments a year are now needed to control mites. This says that something has gone wrong. The pathogens that Varroa mites bring into a colony are another factor. The Varroa jacobsoni mites that co-evolved with Apis cerana in Asia has evolved to become Varroa destructor: as the name suggests, a bigger, more robust mite that causes much more damage. How did it get here? Through illegal imports: for example, Tim used to hear Florida bee breeders brag about bringing foreign queens into the U.S. in their shirt pockets . Now it's here, wreaking havoc: commercial beekeepers can't make money off dead bees, and many feel that research scientists are out of touch with that reality.

"Poisoning the womb of the hive"? This is Randy Oliver's phrase, but it reflects what Tim raised next: the dangers of using chemicals in our hives. Kim Flottum told Tim that within three issues of *Bee Culture*, people moved from deploring pesticides to arguing that they were the only way to control mites. Approaches like genetic control or breeding for resistance quickly got ignored. Is "hygienic behavior" the fix? Tim thinks hygienic behavior "is lame" since he's seen bees "cannibalize healthy brood." Mexican beekeepers are actually ahead of us in mite control now because of – bee-lieve it or not – the hardy Africanized bee, which is aggressive but now manageable because of careful breeding and insemination. Back in the USA, we rely on chemicals like Tactic (amitraz) – we keep it in the colony year-round. Judy Wu, studying for her Master's at WSU several years ago, analyzed chemicals found in wax: she found fluvalinate, cumaphos, chlorpyrifos, and metabolites of amitraz. 4 of the 5 chemicals she found were introduced by beekeepers. The USDA looked into this and found 21 different chemicals in wax and bee bread.

How about agricultural chemicals like neonicotinoids? Tim is not a fan of pesticides: he got out of commercial beekeeping after getting doused by a plane spraying chemicals while he was sleeping in his truck. It is mainly foragers who get hit by direct application of agricultural pesticides. However, it is true that the systemic action of neonicotinoids used to treat seeds does affect more bees through ingestion of honey and pollen.. Neonicotinoids are a prophylactic treatment, used by farmers who are not considering integrated pest management. It is not illogical, Tim commented, that beekeepers are associating neonics with bee losses. However, he noted that the studies done thus far show correlation – but correlation is not causation. Tim noted that the now-notorious Harvard paper that named neonics as the cause of CCD "has been blasted and was badly written." Before we point the finger at neonics, we need better data. In fact, neonics are relatively safe for mammals because of their low toxicity, and this makes them attractive to use. Today, more than 465 products sold in Washington state contain neonics. These chemicals are not enough to kill bees outright, but when fed to workers, to brood, to queen:

theoretically, there is a reduction in overall colony strength. Some studies done with field-realistic dosages of neonicotinoids – that is, dosages akin to what foragers bring back to colonies in real life – have sublethal, cumulative effects on bees' learning behavior and ability to forage effectively. These effects are much harder to quantify: however, field-realistic doses of imidacloprid have, so far, not been credibly associated with mortality.

WSU's Washington State Neonicotinoid Study: Here in Washington, Tim and Steve Sheppard sampled148 apiaries this year, specifically looking for neonic concentrations in bee bread. Tim personally visited 138 apiaries. In the study, they sampled a two inch diameter area of comb with bee bread, taking one sample of wax from each hive, 3 samples per apiary. They divided big commercial apiaries into sections (groups of 30). The holes they drilled were filled up by the bees within a couple of days during good honey flows. Data are still being analyzed, but so far, they have found zero detectable levels of neonicotinoids at 5 parts per billion. That does not mean that neonics are not there: but they did not find them. If 50 parts per million cause damage (some say 20), and they cannot find them even at 5 parts per million, to Tim, these findings do not justify outlawing neonicotinoids. Alternative ways to protect crops are being sought – for example, some researchers are looking into using spider venom against piercing/sucking insects – this may prove to be better than using neonics in the long run. For now, though, neonicotinoids are what farmers have, and research does not support banning them.

The Smorgasbord of Potential Culprits in Bee Losses: Every month, new issues seem to be touted as "the cause" of bee collapse. For example, in London, there are allegations that pollution is crippling bees' capacity to smell. A New York Times article noted that selenium could be the problem. But in reality, Tim notes that many things are causing the problem. Nosema disease is a major factor: there is some evidence that neonicotinoids make bees more susceptible to Nosema. Many samples that are sent to the diagnostic lab at WSU have tested positive for Nosema ceranae. Also, now 25 viruses are detectable in bees, with wounds caused by Varroa as their vector. Further, monoculture agriculture creates food deserts for bees: no riparian areas. In California, after e-coli was found in crops, farmers and officials wiped out hedgerows and decimated anything except the target crops.

What Role Do We Beekeepers Play? However, big agriculture is not alone in doing that. Look at industrial beekeeping: Tim gave an example of one area in which huge numbers of bees are all fed sugar syrup. Literal tanker trucks of syrup are brought in, giving artificial feed to these bees 24/7. May Berenbaum at the University of Illinois recently showed that when bees are fed only sugar syrup, the gene responsible for helping bees detoxify does not turn on: when they are fed honey, though, that gene is turned on. Beekeepers need to look their own role in bee collapse the large operation that Tim described lost 40% of bee colonies after feeding only sugar syrup.

"We Live in a Toxic World": Tim concludes that the underlying problem is: we live in a toxic world. Native pollinators are at even greater risk than honey bees, as no one is caring for them. We need to change mindsets: for example, to encourage the farming community not to spray during bloom times. We need to develop products or strategies that reduce impact on pollinators. As breeders, we need to select for increased nectar and pollen production: that, in turn, will improve nutrition and attraction. Further, we need to promote natural vegetation and pollinator habitat. We need to continue

to seek short- term solutions to detection and treatment while also aggressively funding and implementing long term strategies and breeding programs. More money should be allocated for research: Tim added that he does not get those funds as an Extension agent, but that we need to learn more about the interactions of various stressors on bees. We need to develop non-chemical management strategies: to expand outreach education and stop pandering to the industry – not only the agricultural industry, but the beekeeping industry.

The Critical Role of Habitat: Echoing messages LCBA members heard earlier this year from Franclyn Heinecke and Bill Wamsley, Tim noted that we need to stop wiping out weeds and invasive plants: "it's delusional to think we could wipe out tanzy and scotch broom." Instead, we need to assess area by area, not just spray because it is easy and convenient via helicopter. We must also promote habitat. May Berenbaum said, "If you want to help bees, plant more flowers." We need to involve the Deparment of Transportation in roadside beautification and the conservation reserved enhancement program (CREP), planting in reclaimed areas, marginal or unused areas, and preserving riparian or marshy areas. In this way, Tim said, we can "get real about how to protect bees." When you plant a bee garden, consider abundance, sequence, diversity, and pesticide use. As many of us saw when the forage dried up in august, the psychology of bees improves when natural food is available. For good lists of plants to put in, see www.pollinator.org. Also, BeeSmart "has an app for that" which you can install on your phone, inputting your zipcode to see what plants work in your area.

Finally, Beekeepers Can Step Up Our Game: Tim noted that when he was doing the bee bread sampling study, he saw a lot of bad beekeeping techniques. Timing, he commented, is so important: it's not just what you do, but when you do it. We need to monitor our bees to help them be ready to take advantage of the nectar flow. He saw bees without enough foundation: they had already plugged out their available storage space before the honey flow had started. Also, he saw too many splits being done early on when probably weaker colonies should have been combined. He urged us not to be afraid to squish a low-performing queen, pull out her spermatheca, and see how well mated she was.

QUESTION & ANSWER PERIOD: Norm asked Tim if his weed patches are keeping bees alive? Tim admitted that he does still buy and feed a lot of sugar when forage dries up. However, we can plant to encourage better nutrition. Tim's notorious "bee beard" photo, he said, shows that bees are stimulated in predictable ways, and nutrition is one way. He noted that the urged the Extension agent in Yakima not to cut dandelions – maybe they do compete with cherries, but bees need diverse protein sources. Another member asked whether climate change was influencing bee losses: Tim thinks yes, because as the climate warms, forage dries up sooner.

Tim was asked how bee breeders selected against tracheal mites. This was done by looking specifically for it and selecting bees that showed they were not susceptible, then breeding from those bees. If beekeepers find a tracheal mite problem relatively rare now, he suggests re-queening to deal with it. Norm raised the issue of the genetic bottleneck, asking whether breeding from feral bees is a solution. Tim suggested that we may not know for certain that feral bees truly do have diverse genetics: they could be someone's package that swarmed. "Sorry, survivor bee people," Tim said, "I don't buy it." However, Tim agrees that we need diversity of genes to improve selection. He strongly encourages bee

groups to raise their own local queens. He urged us to invite Sue Cobey down: "She's patient," Tim said. "I just yell at people if they go too slow." But seriously, he urges that we look at our colonies, decide whose traits we want, and then artificially inseminate, graft from those queens. A closed population queen breeding system is an effective way to select for bee improvement. When WSU started with the New World Carniolan, they were constantly selecting and making sure there was a mix within the spermotheca: they were not trying to breed individual bees. "You need to think not of pedigree, like your dog, but rather a population." Norm asked for a show of hands: how many members have done artificial insemination for queens? None of us had. Maybe in 2015!

Gary Stelzner noted that he's feeding sugar syrup heavily and pollen patties: he sees the syrup disappearing, but not much pollen patties. Tim answered that there could be a number of variables for they don't take the patties: they may not need more pollen supplies – he'd have to look in the colony," but even then I'd be guessing." Bee bread can contain a lot of fungicides, which are detrimental to bees, as Gloria de Grandi-Hoffman has shown. Bees need enzyme and microbial activity to be able to break down nutrients.

Gary Kalich held up a hive tool and asked Tim if it belonged to Sue Cobey. Tim was delighted to have it returned, commenting that someone might have found their garden trowel beside a hive after he sampled their bee bread, since he lost her tool and had to use the trowel to finish his day's inspections.

Kent Yates, who knows May Berenbaum and Gene Robinson from his time in Illinois, noted that they talk a lot about how of the hymenoptera, bees have half the genes that a wasp does, so bees depend greatly on honey for their immune system. Should we, then, be putting honey in with sugar syrup when we feed? Tim thinks no - because of the potential for spreading bacterial disease throughout your operation. Honey can harbor disease organisms. Tim says that May's point is that an exclusive diet of sugar is a problem – bees need some natural nectar in colony. Rick asked how long the detoxification gene takes to turn on: Tim said for that, he'd need to ask May.

All present thanked Tim for a highly informative and entertaining presentation!